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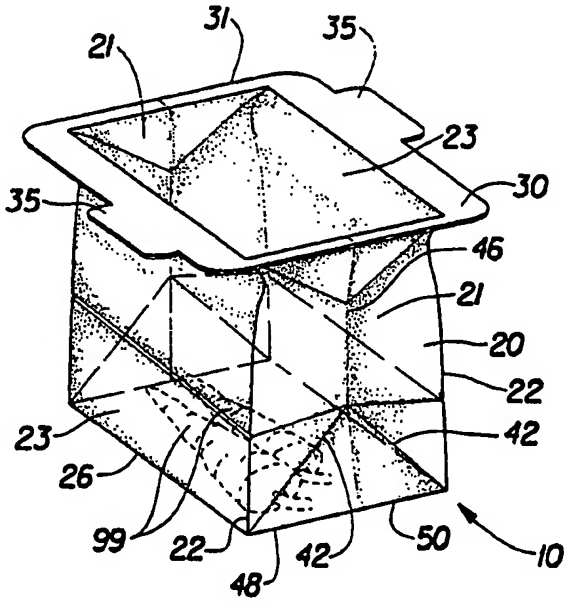
(54) Title: FLEXIBLE, COLLAPSIBLE, SELF-SUPPORTING STORAGE BAGS AND CONTAINERS

(57) Abstract

The present invention provides a flexible storage bag (10) comprising at least one sheet of flexible sheet material assembled to form a semi-enclosed container having an opening defined by a hinged peripheral flange (31). The hinged flange includes a closure means for sealing the opening to convert the semi-enclosed container to a closed container. When the bottom is placed on a horizontal surface the container is self-supporting and maintains the opening in an open condition. The present invention also provides a collapsible, stackable, self-restorable container (101) comprising a unitary continuous tubular side wall having a first open end and a second open end defining an axial direction extending through the first and second open ends. The tubular sidewall is collapsible in response to an externally-applied force exerted in its axial direction and is self-restorable when the force is removed. A lid (401) attached to the tubular side wall for selectively converting the semi-enclosed container to a closed container completes the storage container, and a closure means is provided for sealing the lid to the tubular sidewall.



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FLEXIBLE, COLLAPSIBLE, SELF-SUPPORTING STORAGE BAGS AND CONTAINERS

FIELD OF THE INVENTION

The present invention relates to flexible storage bags and containers, particularly those suitable for use in the containment and protection of various items including perishable materials. The present invention further relates to such flexible storage bags and containers having improved sealability for containment and protection of items contained within under a wide range of in-use conditions.

BACKGROUND OF THE INVENTION

Flexible storage bags for use in the containment and protection of various items, as well as the preservation of perishable materials such as food items, are well known in the art. Such bags typically comprise a rectangular sheet of polymeric film folded upon itself and sealed along two edges to form a semi-enclosed container having two flexible opposed sidewalls, three sealed or folded edges, and one open edge. A closure integrally formed with the bag such as an interlocking rib-type seal or separately provided such as a plastic or paper-clad-wire tie completes the containment assembly.

As utilized herein, the term "flexible" is utilized to refer to materials which are capable of being flexed or bent, especially repeatedly, such that they are pliant and yieldable in response to externally applied forces. Accordingly, "flexible" is substantially opposite in meaning to the terms inflexible, rigid, or unyielding. Materials and structures which are flexible, therefore, may be altered in shape and structure to accommodate external forces and to conform to the shape of objects brought into contact with them without losing their integrity. Flexible storage bags of the foregoing variety are typically formed from polymeric film, such as polyethylene or other members of the polyolefin family, in thicknesses of between about 0.0002 inches to about 0.002 inches. Such films are frequently transparent but sometimes are opaque and/or colored.

Flexible storage bags of the currently commercially available variety provide a means of conveniently storing a wide range of objects and materials in a generally disposable containment device. While flexible storage bags of the foregoing variety have enjoyed a fair degree of commercial success, their reliance upon mechanical closures tends to cause difficulty in operation for individuals having impaired manual dexterity such as children, the elderly, arthritis patients, etc. Moreover, such mechanical closures typically require alignment of mechanical elements for operation which can prove

challenging for those with impaired vision or impaired hand-eye coordination. Many mechanical closure mechanisms also provide leakage sites at such locations as the end of interlocking channels where liquid or gases can leak into or out of the bag.

In an attempt to address this issue alternative closure mechanisms have been developed which rely upon strips or regions of adhesive to bond superimposed regions of the bag. While these closures address some of the difficulties in utilizing separate closure elements or interlocking mechanical elements, some adhesive closure mechanisms require removable liners to protect the adhesive from premature activation, thus adding additional elements for assembly and an additional activation step before use. Moreover, some protected adhesive configurations require interlocking grooves, channels, or protrusions which must be properly registered to engage the adhesive, thus again raising the visual and coordination requirements of conventional mechanical closure mechanisms.

While such flexible storage bags are generally highly efficient for storage before use, for many storage situations it is desirable to minimize the amount of air and/or free space above or around the contents which is trapped within the bag after closure to minimize storage space of filled bags and to aid the effectiveness of the bag in preservation of perishable items. Notwithstanding the type of closure mechanism employed, it is often difficult with conventional flexible storage bags to only partially close the bag and expel trapped air before completing the closure as this again requires a certain amount of manual dexterity and visual aptitude.

Conventional flexible storage bags also create an inherent challenge in terms of being able to hold the flexible or flaccid bag in an open condition with at most one hand so that the other hand can manipulate another container to pour the contents into the bag or peel, cut, or trim items for insertion into the bag. It is also difficult to maintain the proper (usually upright) orientation of the opening of the bag during such filling operations. While rigid containers and flaccid containers with reinforced opening perimeters have been developed for such uses, their comparatively higher cost and limited economical disposability leave room for improvement. Notwithstanding the issue of maintaining the container or bag opening in an open condition, there also remains a need for a flexible yet self-standing container with the foregoing attributes to facilitate easy hands-free filling. Flexible storage bags on the other hand which are constructed of more inexpensive materials to promote disposability typically lack the structure necessary for stable stacking of bags after filling.

With regard to rigid or semi-rigid containers, it is well recognized that such containers have also realized a fair degree of commercial success in providing a means

for storing a wide variety of contents. Such containers typically have an opening which maintains an open condition for filling and are typically self-supporting with the opening in the proper orientation for filling. Such containers also are frequently provided with flat bottoms and tops to provide stackability. However, such containers are typically constructed of more expensive materials such that disposability is limited. At the same time, the useful life of such containers is limited by damage, soiling, or other degradation naturally occurring in use, including degradation of the typical mechanical closure mechanisms. Storage of such three-dimensional, rigid or semi-rigid containers when empty is also a concern, since they occupy as much volume empty as they do in a filled condition. Due to their comparatively fixed-volume construction, it is also difficult to minimize the amount of air or free space above or around the contents to minimize storage space of filled containers and to aid the effectiveness of the container in preservation of perishable items. Another concern is the task of matching usually-separate lids or closures with their respective containers for use.

Accordingly, it would be desirable to provide a flexible storage bag or container combining the desirable qualities of both flexible bags and storage containers and minimizing the less desirable qualities of both approaches.

More particularly, it would be desirable to provide a flexible storage bag or container having improved sealability in use.

It would also be desirable to provide a flexible storage bag or container which facilitates venting of trapped air before completion of closure.

It would further be desirable to provide such a bag or container which is capable of being self-supporting in an open condition for filling purposes, yet stores easily by folding into a compact form.

It would still further be desirable to provide a bag or container constructed from inexpensive materials to facilitate disposability which still promotes stable stacking of bags or containers in a filled condition.

It would be yet further desirable to provide such a bag or container which provides the foregoing attributes in a convenient unitary form, obviating the need for separate closure devices.

SUMMARY OF THE INVENTION

The present invention provides a flexible storage bag comprising at least one sheet of flexible sheet material assembled to form a semi-enclosed container having an opening defined by a hinged peripheral flange. The hinged flange includes a closure means for sealing the opening to convert the semi-enclosed container to a closed

container. The bag includes at least one pair of opposed gussets formed in the sheet material extending in a direction normal to the opening and a substantially planar bottom extending in a direction substantially parallel to the opening. When the bottom is placed on a horizontal surface the container is self-supporting and maintains the opening in an open condition.

The present invention also provides a flexible storage bag having an opening and a closure means for sealing the opening to convert the semi-enclosed container to a closed container. The closure means comprises a strip of material forming at least a portion of the periphery of the opening having a first side facing inwardly toward the opening and a second side facing outwardly of the opening. The first side exhibits an adhesion peel force after activation by a user which is greater than an adhesion peel force exhibited prior to activation by a user.

The present invention also provides a collapsible, stackable, self-restorable container comprising a unitary continuous tubular sidewall having a first open end and a second open end defining an axial direction extending through the first and second open ends. The first open end has a substantially continuous outwardly-extending flange forming a periphery. The tubular sidewall is collapsible in response to an externally-applied force exerted in its axial direction and is self-restorable when the force is removed. The container further includes a bottom panel unitarily formed with the second open end of the tubular sidewall and enclosing one end of the tubular sidewall to form a semi-enclosed container. A lid attached to the tubular sidewall for selectively converting the semi-enclosed container to a closed container completes the storage container, and a closure means is provided for sealing the lid to the tubular sidewall. The closure means comprises a strip of material forming at least a portion of the periphery having a first side facing inwardly toward the opening and a second side facing outwardly of the opening, with the first side exhibiting an adhesion peel force after activation by a user which is greater than an adhesion peel force exhibited prior to activation by a user.

The present invention also provides a collapsible, foldable, stackable, and self-supporting container comprising semi-enclosed container body having two opposed side walls, two opposed end walls between the side walls, and a bottom panel enclosing one end of the container body. Each of the side walls includes a gusset extending in a direction substantially parallel to the bottom panel. The container further includes a lid attached to the container body for selectively converting the semi-enclosed container to a closed container. Finally, the container includes a closure means for sealing the lid to the container body. In accordance with the present invention the side walls and end walls are inwardly foldable toward one another, such that the container is collapsible in a direction

normal to the lid and bottom panel while being substantially self-supporting while the side walls and end walls are in their unfolded orientation.

The present invention also provides a storage container having an opening and a closure means for sealing the opening to convert the semi-enclosed container to a closed container. The closure means comprises a strip of material forming at least a portion of the periphery of the opening having a first side facing inwardly toward the opening and a second side facing outwardly of the opening. The first side exhibits an adhesion peel force after activation by a user which is greater than an adhesion peel force exhibited prior to activation by a user.

Accordingly, the flexible storage bags and containers of the present invention combine the desirable qualities of both flexible bags and storage containers and minimize the less desirable qualities of both approaches by providing improved sealability, facilitating venting of trapped air before closure, being self-supporting in an open condition for filling, storing easily by folding into a compact form, and being unitarily constructed from inexpensive materials to promote disposability and obviate the need for separate closure devices.

BRIEF DESCRIPTION OF THE DRAWINGS

While the specification concludes with claims particularly pointing out and distinctly claiming the present invention, it is believed that the present invention will be better understood from the following description in conjunction with the accompanying Drawing Figures, in which like reference numerals identify like elements, and wherein:

Figure 1 is a perspective view of a preferred embodiment of a flexible storage bag of the present invention, in an open configuration;

Figure 2 is a perspective view of the flexible storage bag of Figure 1 in a partially closed condition after filling;

Figure 3 is a perspective view of the flexible storage bag of Figure 1 in a closed and sealed condition after filling;

Figure 4 is a perspective view of the flexible storage bag of Figure 1 with the sealed edge of the bag being optionally folded over to provide a flat upper surface for stacking;

Figure 5 is a perspective view of the flexible storage bag of Figure 1 in a partially folded condition;

Figure 6 is a perspective view of the flexible storage bag of Figure 1 in a fully-folded, flattened condition;

Figure 7 is a perspective view similar to Figure 6 of an alternative flexible storage bag having no reinforcing panel;

Figure 8 is a perspective view of a storage container in accordance with the present invention in a closed condition;

Figure 9 is a perspective view of the storage container of Figure 8 in an open condition and partially filled with solid objects;

Figure 10 is a perspective view of the storage container of Figure 8 in a fully-flattened condition;

Figure 11 is a partial elevational sectional view of the edge portion of the container of Figure 8 depicting the relationship of the closure means to the rest of the container;

Figure 12 is a partial elevational sectional view similar to that of Figure 11 but depicting an alternative container construction wherein the peripheral portions of the container body and lid are formed as a composite structure;

Figure 13 is a partial elevational sectional view similar to that of Figure 11 but depicting the partial collapse of the container in response to an externally applied force;

Figure 14 is a partial elevational sectional view similar to that of Figure 13 but depicting the container in a fully collapsed condition;

Figure 15 is a perspective view of a storage container in accordance with the present invention in a closed condition;

Figure 16 is a perspective view of the storage container of Figure 15 in an open condition and partially filled with solid objects;

Figure 17 is a perspective view of the storage container of Figure 15 in a horizontal position in preparation for folding;

Figure 18 is a perspective view of the storage container of Figure 15 in a partially folded and collapsed condition;

Figure 19 is a perspective view of the storage container of Figure 15 in a fully folded and collapsed condition;

Figure 20 is a top plan view of a preferred embodiment of a material suitable for use as a closure means of the present invention, disclosing a piece of material having truncated conical protrusions surrounded by an interconnected pattern of substance;

Figure 21 is an enlarged partial top plan view of the material of Figure 20, showing an array of protrusions;

Figure 22 is an elevational sectional view, taken along section line 22-22 of Figure 21, showing the protrusions acting as standoffs for a substance layer between

protrusions, such that a target surface contacting the outermost ends of the protrusions does not contact the substance layer;

Figure 23 is an elevational sectional view similar to Figure 22, showing the effect of pressing the material against the target surface, such that protrusions deform by substantially inverting and/or crushing to allow the substance layer between protrusions to contact the target surface;

Figure 24 is an elevational sectional view of the material of Figures 20-23, showing preferred dimensional relationships of protrusions; and

Figure 25 is a schematic view of a suitable method of making a material suitable for use as a closure means of the present invention, showing a forming screen as a belt wrapped around a vacuum drum and a drive pulley.

DETAILED DESCRIPTION OF THE INVENTION

Figure 1 depicts a presently preferred embodiment of a flexible storage bag 10 according to the present invention. In the embodiment depicted in Figure 1, the flexible storage bag 10 includes a bag body 20 formed from a piece of flexible sheet material folded and bonded to itself to form a semi-enclosed container having an opening defined by flange 31. Flexible storage bag 10 also includes closure means 30 associated with flange 31 for sealing the open end of the container 10 to form a fully-enclosed container or vessel as shown in Figure 3. Closure means 30 is selectively openable, sealable, and resealable, as will be described hereinafter.

In the preferred configuration depicted in Figure 1, the closure means 30 completely encircles the periphery of the opening formed by flange 31. However, under some circumstances a closure means formed by a lesser degree of encirclement (such as, for example, a closure means disposed along only one side of flange 31) may provide adequate closure integrity. The flange 31 may be either unitarily formed with the bag body 20 or provided as a separate material element joined to the bag body. When provided as a separate, preferably more rigid material element, it is presently preferred that the bag body material be formed into at least a small peripheral flange at its upper edge (defining the opening) with pleated corners so as to form a suitable junction point for joining the bag body to the flange.

Flexible storage bag 10 is suitable for containing and protecting a wide variety of materials and/or objects contained within the bag body. Figure 1 depicts the storage bag 10 in an open condition wherein the closure means 30 has been released such that flange 31 may be opened to admit materials and/or objects into the interior of the bag body

portion of the storage bag 10. In Figure 1 a plurality of generic solid bjects 99 are shown within the storage bag 10.

While the flexible storage bag described above with regard to Figure 1 provides many advantages compared with flexible storage bags and storage containers commonly available, it also includes additional features to enable the bag to assume a self-supporting configuration to facilitate product access and product filling without manual support for greater ease of use.

As utilized herein, the term "self-supporting" is utilized to refer to materials, structures, or containers which are capable of maintaining their orientation in a plane parallel to the direction of the force of gravity. For example, a self-supporting material, particularly a sheet material, may be held so that it extends upwardly parallel to the direction of the force of gravity and maintain its orientation without folding over or collapsing. Non-self-supporting materials typically will fold over or collapse and not be capable of being held parallel to the force of gravity (i.e., "vertically") unless they are held so that they extend downwardly from their point of support. Correspondingly, a self-supporting bag or container is capable of maintaining its orientation with surfaces extending upwardly from their base of support in opposition to the force of gravity without folding over upon itself or collapsing.

In the preferred embodiment of Figure 1, the flexible storage bag 10 comprises two generally planar side panels 23, two generally planar, gusseted end panels 21, and a generally planar bottom panel 50, which panels form a semi-enclosed container having an opening defined by upper flange 31. Side panels 23 include side edges 22 and bottom edges 26, while end panels 21 include bottom edges 48 and gussets of generally conventional design having converging base creases 42 and medial creases 46. In the configuration depicted in Figure 1, the bag is in its self-supporting, open condition. Flange 31 is preferably sufficiently resilient and rigid to aid in holding the open end of the bag in an open condition as shown in Figure 1, particularly when the hinges 32 (best seen in Figure 2) are living hinges which resiliently bias the flange 31 toward the open configuration seen in Figure 1. The structure of the flexible storage bag thus enables the bag to assume a self-supporting configuration to facilitate product access and product filling without manual support.

As is known in the art, gusseted bags typically provide a self-supporting open bag which may be readily filled or emptied with a minimum of difficulty. However, unlike most conventional gusseted bags the flexible storage bags of the present invention include a selectively-activatible closure means 30 as described herein. Accordingly, in

addition to being self-supporting the gusseted flexible storage bags 10 also provide the desirable sealing attributes described herein.

Figure 2 depicts the flexible storage bag of Figure 1 in a partially closed condition after the objects 99 have been inserted. As shown in Figure 2, the flange 31 preferably includes a pair of hinges 32 which are preferably unitarily formed in the material of the flange 31 as is typical of hinges commonly referred to as "living hinges". Hinges 32 are preferably configured so that they provide at least a slight biasing toward the open configuration shown in Figure 1 to aid in holding the container in an open, self-supporting condition.

Figure 3 depicts a flexible storage bag typical of that shown in Figure 1, but in a sealed condition such as after insertion of a product into the interior of the bag. Accordingly, the medial creases 46 of the gussets have been pushed inwardly from the configuration of Figure 1 in a manner similar to that of Figure 2. However, the closure means 30 has been subjected to activation by a user so that overlying superimposed regions of the closure means are adhesively bonded to one another to form a secure, substantially fluid- and vapor-impervious seal for the opening formed by the flange 31 of the bag. In the preferred configuration shown in Figure 1, the closure means entirely encircles the open end of the bag defined by the flange 31 so that complete adhesion of the entire periphery is assured upon activation.

As will become apparent by viewing the sequence of steps depicted in Figures 1-3, the flexible sheet material utilized to form the body of the bag is sufficiently flexible and yieldable to accommodate the motion of the hinged flange as it moves between the open configuration of Figure 1 and the closed configuration of Figure 3. More particularly, the end panels 21 are sufficiently flexible to fold or pleat upon themselves as the hinge portion of the flange pivots downwardly toward the bottom panel 50 while the outer portions of the flange (near tabs 35) move upwardly toward one another.

The illustrations of Figures 1-3 also demonstrate another inherent performance advantage of the flexible storage bags of the present invention. More particularly, the hinged peripheral flange orients the closure means 30 in a direction perpendicular to the axis of the opening of the flexible storage bag and perpendicular to the inner wall surfaces adjacent to the flange. This orientation tends to isolate the closure means from the materials being inserted into the bag through the opening and prevent contamination thereof before use. At the same time, closure of the bag brings the closure means through a 90 degree transition from horizontal to vertical, from perpendicular to the axis of the opening to parallel to the axis of the opening, effectively transitioning closure of

the flexible storage bag from that of a container-like device to that of a bag-like device, combining the advantages of both in doing so.

To open the bag of Figure 3, a user may grasp the pair of tabs 35 and pull them in laterally opposite directions to initiate and propagate separation of the opposed halves of flange 31, and hence closure means 30. Alternatively, marginal edges (which as mentioned above are preferably partially adhesive-free) of the bag above the closure means may be grasped and pulled apart.

Figure 4 depicts the closed and sealed bag of Figure 3 with the top portion optionally folded over substantially parallel to the bottom 50, so that a stable stackable configuration is obtained whereupon other containers, articles, or the like may be stably placed upon the bag. Again, the flexible nature of the material of the bag body makes such a folding-over a viable option for efficient storage. The gusseted, pleated sidewall structure with spaced, defined corners adds additional integrity and stability to the filled bag, improving stackability in use and adding stability as well in terms of overturning or the like.

In addition to being self-supporting, gusseted flexible storage bags 10 are also readily foldable or collapsible to provide easy storage occupying minimal space. Figure 5 depicts a gusseted flexible storage bag 10 as shown in Figure 1 but in a partially folded or collapsed condition. Accordingly, medial creases 46 have been pushed inwardly toward one another, bringing side edges 22 toward one another on opposite sides of the medial creases 46 and somewhat parallel to the base creases 42 in their vicinity. Such a predictable folding feature independent of the closure means also permits the volume of the container to be diminished after the contents are inserted to minimize the amount of air and/or free space above or around the contents which is trapped within the bag after closure to minimize storage space of filled bags and to aid the effectiveness of the bag in preservation of perishable items. Figure 6 shows a gusseted flexible storage bag 10 in a more fully folded condition wherein folding continues until the bottom 50 is substantially parallel with the sides. Also depicted in Figure 6 is the optional reinforcing panel 55 which adds additional integrity and stability to the generally rectangular, planar bottom panel 50.

The addition of additional reinforcement to the bottom panel lowers the center of gravity of the empty bag for greater stability prior to and during filling, increases the stiffness of the bottom of the bag for added stability in most circumstances filled or empty, and reduces the likelihood of the bottom of the bag bowing when filled with heavier contents. The inward folding of the flaps forming the bottom panel 50 of the bag body as shown in Figure 7 also performs a similar role. The reinforcing panel may be of

a similar material to the bag material or may be of a different more or less durable material, and is secured to the bottom panel by adhesive application or other suitable means. It is presently preferred that when a reinforcing panel is employed that it be placed on the exterior surface of the bottom panel rather than on the interior surface in order to provide support and reinforcement without adding additional surfaces, joints, and crevices on the interior of the bag where they may provide sites for trapping portions of the bag contents and creating cleaning difficulties.

Figure 7 depicts a bag similar to that of Figure 6, but without the optional reinforcing panel on the bottom 50. In Figure 7, therefore, the seam and folding structure of the bottom 50 is clearly visible. Such a folding configuration is typical of conventional folded, gusseted bags having a square or rectangular bottom and is sealed appropriately by adhesives, heat seals, or the like so as to provide a substantially liquid-tight and gas-tight bottom structure.

Various compositions suitable for constructing the flexible storage bags of the present invention include substantially impermeable materials such as polyvinyl chloride (PVC), polyvinylidene chloride (PVDC), polyethylene (PE), polypropylene (PP), aluminum foil, coated (waxed, etc.) and uncoated paper, coated nonwovens etc., and substantially permeable materials such as scrims, meshes, wovens, nonwovens, or perforated or porous films, whether predominantly two-dimensional in nature or formed into three-dimensional structures. Such materials may comprise a single composition or layer or may be a composite structure of multiple materials, including a substrate material utilized as a carrier for a substance. Materials found suitable for use in accordance with the present invention include a low density polyethylene film, 0.004 or 0.006 inch thickness, commercially available from Huntsman Film Products Corp. under the manufacturer's designation X420.

Figure 8 depicts a presently preferred embodiment of a storage container 10A according to the present invention. In the embodiment depicted in Figure 8, the storage container 10A includes a container body 20A preferably unitarily formed from a piece of sheet material and a lid 40A preferably unitarily formed with the container body 20A or at least hingedly attached to the container body at hinge line 45A. Storage container 10A also includes closure means 30A located adjacent to edge 28A for sealing the peripheral portions of the lid 40A and container body 20A to form a fully-enclosed container or vessel as shown in Figure 8. Closure means 30A may comprise the marginal portion of the lid 40A, the marginal flange portion 25A of the container body 20A, or both. Hinge line 45A preferably comprises a unitary living hinge, and may optionally be provided as

a line of weakness by scoring, perforations, or the like which may optionally permit the lid to be separated from the container body.

In the preferred configuration depicted in Figure 8, the closure means 30A completely encircles the periphery of the opening formed by edge 28A. However, under some circumstances a closure means formed by a lesser degree of encirclement (such as, for example, a closure means disposed along all portions of edge 28A except the hinged portion at hinge line 45A) may provide adequate closure integrity.

Storage container 10A is suitable for containing and protecting a wide variety of materials and/or objects contained within the container body. Figure 9 depicts the storage container 10A in an open condition wherein the closure means 30A has been released such that edge 28A may be opened to admit materials and/or objects into the interior of the body portion of the storage container 10A. In Figure 9 a plurality of generic solid objects 99A are shown within the storage container 10A.

Resiliently deformable storage containers of the present invention provide the user not only with product protection, but with temporary compactability for easy, compact storage wherein the compacted container tends to self-restore to near its original shape for easy use. In an uncompressed state, the storage container is "self-supporting" in its expanded, restored condition for easy filling and use.

As utilized herein, the term "self-supporting" is utilized to refer to materials, structures, or containers which are capable of maintaining their orientation in a plane parallel to the direction of the force of gravity. For example, a self-supporting material, particularly a sheet material, may be held so that it extends upwardly parallel to the direction of the force of gravity and maintain its orientation without folding over or collapsing. Non-self-supporting materials typically will fold over or collapse and not be capable of being held parallel to the force of gravity (i.e., "vertically") unless they are held so that they extend downwardly from their point of support. Correspondingly, a self-supporting bag or container is capable of maintaining its orientation with surfaces extending upwardly from their base of support in opposition to the force of gravity without folding over upon itself or collapsing.

Referring again to Figure 9, the storage container body 20A comprises a deformable substantially continuous tube or hoop of material. In the illustrative configuration depicted wherein the container has a substantially rectangular shape, the tube or hoop forms a substantially continuous sidewall comprising sidewall portions 21A, 22A, 23A and 24A. The tube or hoop may be of nearly any desired cross-section, but is typically rectangular. Regardless of cross-section, the container body which forms a semi-enclosed container is preferably free of internal corners where walls, bottom

panels, etc. join one another to facilitate easy removal of container contents and ease of cleaning. One end of the tube forming the tubular sidewalls remains open for access to the interior of the container and is selectively closeable by a pivotable lid 40A. The other end of the tubular sidewall is enclosed by a bottom panel 50A, which may be comprised of the same resilient material as the tubular sidewall. In a particularly preferred embodiment the container comprises a relatively thicker and stiffer lid and bottom wall comprised of a resiliently deformable material and oriented generally parallel to one another.

Resiliently deformable packages of the present invention can be made from low cost materials, are easy to produce and can undergo numerous deformation cycles while maintaining their functionality and aesthetic appearance.

In general, resiliently deformable storage containers of the present invention may employ greater side wall thicknesses as the resiliency of the material comprising the side walls increases. Conversely, as the resiliency of the materials used to construct the side walls decreases, thinner side wall thicknesses are preferably employed to maximize the resiliently deformable characteristic of storage containers of the present invention.

As shown in Figure 10, the circumferential attachment of the intersecting sidewalls 21A, 22A, 23A, and 24A defines a tube or hoop which is easily deformable by an externally applied force "F", as shown by the "pleating" effect depicted along the sidewalls. Depending upon the nature of the materials utilized for the tubular sidewall(s) and the radius of the corners where adjacent sidewalls meet, this pleating effect may be more or less concentrated at the corners and more generalized bowing or buckling in the medial portions of the sidewalls. This deformation occurs due to the thinness of the side walls and the resiliently deformable characteristic of the material comprising the side walls. When the deforming force "F" is removed from the top of the resiliently deformable storage container (lid 40A in Figure 10) the tube or hoop formed by the interconnected side walls tends to cause the container body 20A to self-restore toward its substantially original undeformed shape, as generally shown in Figures 8 and 9, substantially eliminating the folds or pleats depicted in Figure 10. As used herein, the term "self-restore" refers to the tendency of resiliently deformable storage container 10A to return toward its original undeformed condition without taking on a permanent set due to the deformation when the deforming forces are removed. This recovery may not fully restore the package to its exact original shape and appearance. However, unlike substantially rigid packages of the prior art, resiliently deformable storage container 10A will self-restore to a degree which is sufficient to at least facilitate continued functional use. A more detailed discussion of self-restorable containers is provided in commonly-

assigned U.S. Patent No. 5,379,879, issued January 10, 1995 to Muckenfuhs et al., the disclosure of which is hereby incorporated herein by reference.

If thermoforming is employed to produce storage container body 20A and/or lid 40A, it is also feasible to produce highly decorative effects in the resulting storage container at relatively low cost, simply by preparing a suitable mold. For example, textures, logos, instructions, etc., can be molded into the container body 20A and/or lid 40A to produce a desirable aesthetic appearance and/or integral brand identification and/or usage instructions, all without the need for ancillary printing or labeling operations. Twisting forces which may be applied to the storage container will be resisted not only by the tube or hoop formed by the intersecting side walls 21A-24A, but also by the torsional resistance of the substantially planar and thicker bottom panel and lid, respectively. Accordingly, both the side walls 21A-24A and the relatively thicker bottom panel and lid help to restore the package toward substantially its original configuration once all of the externally applied forces have been removed from the package.

Referring again to Figure 9, while the lid 40A, side walls 21A-24A, and the bottom panel 50A of the resiliently deformable storage container 10A need not be produced from the same material, there may be certain advantages for doing so. From a manufacturing standpoint, the use of similar materials may make the joining of the lid, the side walls, and the bottom panel to one another easier and less expensive using known techniques, e.g., heat sealing, ultrasonics, etc. Furthermore, with regard to the recycling of the storage container at the end of its useful life, it may be easier if all the elements comprising the storage container are comprised of the same material, thus eliminating the need to separate components from one another prior to material recovery processing.

Figure 11 is a partial cross-sectional view of the storage container 10A depicted in Figures 8 and 9 taken through the sidewall 22A, more clearly depicting the structural relationship between the various components previously described. The flange 25A is depicted as being unitarily formed with the sidewall 22A, which is depicted as being unitarily formed with the bottom panel 50A. Lid 40A is depicted as being unitary. Figure 12, on the other hand, depicts the lid 40A as comprising a central lid panel 42A and a lid frame 44A, either of which may also formed of various elements if desired. The flange 25A is depicted as being smaller, and preferably but optionally still unitarily formed with the sidewall 22A, which is preferably but optionally still unitarily formed with the bottom panel 50A. However, the outer portion of the container body now comprises outer flange 27A which is affixed to and extends laterally outwardly from the

flange 25A. Also shown in Figure 12 is the presence of an optional reinforcing bottom panel 55A provided to enhance the rigidity and resiliency of the bottom of the storage container, and preferably externally provided so as to avoid creating additional surfaces and edges inside the interior of the container body which would create difficulties in cleaning and emptying the container.

The addition of additional reinforcement to the bottom panel lowers the center of gravity of the empty container for greater stability prior to and during filling, increases the stiffness of the bottom of the container for added stability in most circumstances filled or empty, and reduces the likelihood of the bottom of the container bowing when filled with heavier contents. The reinforcing panel may be of a similar material to the container body material or may be of a different more or less durable material, and is secured to the bottom panel by adhesive application or other suitable means. It is presently preferred that when a reinforcing panel is employed that it be placed on the exterior surface of the bottom panel rather than on the interior surface in order to provide support and reinforcement without adding additional surfaces, joints, and crevices on the interior of the container where they may provide sites for trapping portions of the contents and creating cleaning difficulties.

The ability to construct the container of multiple composite elements permits the use of diverse materials such as transparent polymeric panels for lid panels or more rigid, resilient materials for flanges and lid frames independently of the tailoring of materials for the tubular sidewall.

Figures 13 and 14 are partial cross-sectional views corresponding to Figure 11 which depict the storage container in partially and fully-compressed conditions, respectively. As shown in Figure 10, partial collapse or compression of the container in response to an externally-applied force F applied in an axial direction with regard to the axial direction of the tubular sidewall causes a pleating or folding of the tubular sidewall. This collapse continues until a fully-collapsed condition is encountered as depicted in Figure 14 (and Figure 10, in perspective), when overlying pleats or folds meet to form a solid stack of sidewall material and impede further compression of the storage container. Since the sidewall thicknesses are exaggerated beyond those preferred for purposes of illustrative clarity in Figures 11-14, this condition is preferably only reached when the lid and bottom panel are sufficiently close to one another to provide a truly minimal overall container thickness when fully compressed.

With or without additional venting features, the use of the selectively-activatible closure means of the present invention for the primary closure facilitates greater ease of venting or expelling air and/or free space above or around the contents prior to sealing by

providing an easy-to-use sealing mechanism. The body of the storage container may be compressed as described above prior to completing the closure process to reduce the interior volume of the container and the closure process then completed to seal the container.

Various compositions suitable for constructing the storage containers of the present invention include substantially impermeable materials such as polyvinyl chloride (PVC), polyvinylidene chloride (PVDC), polyethylene (PE), polypropylene (PP), aluminum foil, coated (waxed, etc.) and uncoated paper, coated nonwovens etc., and substantially permeable materials such as scrims, meshes, wovens, nonwovens, or perforated or porous films, whether predominantly two-dimensional in nature or formed into three-dimensional structures. Such materials may comprise a single composition or layer or may be a composite structure of multiple materials, including a substrate material utilized as a carrier for a substance. Materials found suitable for use in accordance with the present invention include a polymeric film, 0.012 inch thickness, commercially available from American National Can under the manufacturer's designation DZ-2002-2.

Figure 15 depicts a presently preferred embodiment of a storage container 10B according to the present invention. In the embodiment depicted in Figure 15, the storage container 10B includes a container body 20B preferably unitarily formed from a piece of sheet material and a lid 40B preferably unitarily formed with the container body 20B or at least hingedly attached to the container body at hinge line 45B. Storage container 10B also includes closure means 30B located adjacent to edge 28B for sealing the peripheral portions of the lid 40B and container body 20B to form a fully-enclosed container or vessel as shown in Figure 15. Closure means 30B may comprise the marginal portion of the lid 40B, the marginal flange portion 25B of the container body 20B, or both. Closure means 30B is selectively openable, sealable, and resealable, as will be described hereinafter. Hinge line 45B shown in Figure 16 preferably comprises a unitary living hinge, and may optionally be provided as a line of weakness by scoring, perforations, or the like which may optionally permit the lid to be separated from the container body.

In the preferred configuration depicted in Figure 15, the closure means 30B completely encircles the periphery of the opening formed by edge 28B. However, under some circumstances a closure means formed by a lesser degree of encirclement (such as, for example, a closure means disposed along all portions of edge 28B except the hinged portion at hinge line 45B) may provide adequate closure integrity. The flange 25B may be either unitarily formed with the container body 20B or provided as a separate material element joined to the container body. When provided as a separate, preferably more

rigid material element, it is presently preferred that the container body material be formed into at least a small peripheral flange at its upper edge (defining the opening) with pleated corners so as to form a suitable junction point for joining the container body to the flange. The closure means may be provided on mating portions of either the flange 25B, the lid 40B, or both.

Storage container 10B is suitable for containing and protecting a wide variety of materials and/or objects contained within the container body. Figure 16 depicts the storage container 10B in an open condition wherein the closure means 30B has been released such that edge 28B may be opened to admit materials and/or objects into the interior of the body portion of the storage container 10B. In Figure 16 a plurality of generic solid objects 99B are shown within the storage container 10B.

The ability to construct the container of multiple composite elements permits the use of diverse materials such as transparent polymeric panels for lid panels or more rigid, resilient materials for flanges and lid frames independently of the tailoring of materials for the container body 20B. Lid 40B is depicted as comprising a central lid panel 42B and a lid frame 44B, either of which may also formed of various elements if desired, although lid 40B may also be of unitary construction.

In the embodiment of Figure 15, the storage container 10B comprises two generally planar end panels 50B, two generally planar, gusseted side panels 60B, and a generally planar bottom panel 70B, which panels form a semi-enclosed container having an opening defined by upper flange 25B. End panels 50B include side edges 55B and bottom edges 54B, while side panels 60B include bottom edges 64B and gussets of generally conventional design having converging base creases 62B and medial creases 61B, with lateral creases 63B. In the configuration depicted in Figure 15, the storage container is in its self-supporting, open condition. Flange 25B is preferably sufficiently resilient and rigid to aid in holding the open end of the container in an open condition as shown in Figure 15.

While the storage container described above with regard to Figure 15 provides many advantages compared with flexible storage bags and storage containers commonly available, it also includes additional features to enable the container to assume a self-supporting configuration to facilitate product access and product filling without manual support for greater ease of use.

As utilized herein, the term "self-supporting" is utilized to refer to materials, structures, or containers which are capable of maintaining their orientation in a plane parallel to the direction of the force of gravity. For example, a self-supporting material, particularly a sheet material, may be held so that it extends upwardly parallel to the

direction of the force of gravity and maintain its orientation without folding over or collapsing. Non-self-supporting materials typically will fold over or collapse and not be capable of being held parallel to the force of gravity (i.e., "vertically") unless they are held so that they extend downwardly from their point of support. Correspondingly, a self-supporting bag or container is capable of maintaining its orientation with surfaces extending upwardly from their base of support in opposition to the force of gravity without folding over upon itself or collapsing.

In addition to being self-supporting, gusseted storage container 10B is also readily foldable or collapsible to provide easy storage occupying minimal space. Figure 17 depicts a gusseted storage container 10B as shown in Figure 15 positioned laterally on its side in preparation for folding. Figure 18 depicts a gusseted storage container 10B as shown in Figure 15 but in a partially folded or collapses condition. Accordingly, medial creases 61B have been pushed inwardly toward one another, bringing bottom edges 64B toward and generally parallel to the flange 25B. Figure 19 shows a gusseted storage container 10B in a more fully folded condition wherein folding continues until the bottom 70B is substantially parallel to and in close proximity to the flange 25B. Also depicted in Figure 17 is the optional reinforcing panel 72B which adds additional integrity and stability to the generally rectangular, planar bottom panel 70B. To avoid negatively impacting upon the foldability of the container body, the reinforcing bottom panel 72B preferably includes creases 71B which substantially align with lateral creases 63B for folding as depicted in Figures 17-19. Optional reinforcing panel 72B may also extend upwardly at one or both ends covering or reinforcing end panels 50B.

The addition of additional reinforcement to the bottom panel lowers the center of gravity of the empty container for greater stability prior to and during filling, increases the stiffness of the bottom of the container for added stability in most circumstances filled or empty, and reduces the likelihood of the bottom of the container bowing when filled with heavier contents. The reinforcing panel may be of a similar material to the container body material or may be of a different more or less durable material, and is secured to the bottom panel by adhesive application or other suitable means. It is presently preferred that when a reinforcing panel is employed that it be placed on the exterior surface of the bottom panel rather than on the interior surface in order to provide support and reinforcement without adding additional surfaces, joints, and crevices on the interior of the container where they may provide sites for trapping portions of the contents and creating cleaning difficulties.

The flexible sheet material utilized to form the body of the container is sufficiently flexible and yieldable to accommodate the folding or collapsing of the

container body between the open configuration of Figure 15 and the closed configuration of Figure 19. More particularly, the side panels 60B are sufficiently flexible to fold or pleat upon themselves as the end panels 50B pivot inwardly toward one another as the bottom panel 70B moves toward the lid 40B.

To open the storage container of Figure 15, a user may grasp the pair of tabs 35B and pull them in opposite directions to initiate and propagate separation of the opposed halves of flange 31B, and hence closure means 30B.

In Figures 15-19, the seam and folding structure of the end panels 50B is clearly visible. Such a folding configuration is typical of conventional folded, gusseted bags having a square or rectangular bottom and is sealed appropriately by adhesives, heat seals, or the like so as to provide a substantially liquid-tight and gas-tight panel structure. The gusseted, pleated sidewall structure with spaced, defined corners adds additional integrity and stability to the filled container, improving stackability in use and adding stability as well in terms of overturning or the like.

More specifically, the manner of folding the container body material to form the end panels 50B, as shown in Figures 15-19, results in multiple layers of material forming overlapping flaps 51B and 52B, which lends additional stability and rigidity to the container when these panels are in their extended position of Figure 15 since they function as legs or supports for the container. Moreover, the diagonal folded edges of the flaps 51B and 52B, namely edges 53B, is believed to provide diagonal reinforcing folds or braces which further aid in the construction of end panels 50B from a flexible material which provide the desired level of integrity, self-supportability, and stackability to the container of the present invention.

Various compositions suitable for constructing the storage containers of the present invention include substantially impermeable materials such as polyvinyl chloride (PVC), polyvinylidene chloride (PVDC), polyethylene (PE), polypropylene (PP), aluminum foil, coated (waxed, etc.) and uncoated paper, coated nonwovens etc., and substantially permeable materials such as scrims, meshes, wovens, nonwovens, or perforated or porous films, whether predominantly two-dimensional in nature or formed into three-dimensional structures. Such materials may comprise a single composition or layer or may be a composite structure of multiple materials, including a substrate material utilized as a carrier for a substance. Materials found suitable for use in accordance with the present invention include a low density polyethylene film, 0.006 inch thickness, commercially available from Huntsman Film Products Corp. under the manufacturer's designation X420.

Once the desired sheet materials are manufactured in any desirable and suitable manner, comprising all or part of the materials to be utilized for the bag or container body, the bag or container may be constructed in any known and suitable fashion such as those known in the art for making such bags or containers in commercially available form. Heat or adhesive sealing technologies may be utilized to join various components or elements of the bag to or container themselves or to each other. In addition, the bag or container bodies may be thermoformed, blown, or otherwise molded rather than reliance upon folding and bonding techniques to construct the bag or container bodies from a web or sheet of material.

The closure means depicted in Figures 1-19 may be constructed in any known fashion utilizing any closure configuration, such as folds, pleats, adhesives, or mechanical interlocking closures such as ribs, beads, and grooves, which are known in the art. However, it is presently preferred to utilize a selectively activatible adhesive-bearing structure which provides a secure closure seal upon activation. Accordingly, the closure means preferably comprises a selectively activatible adhesive-like material which bonds opposing material surfaces to one another across the opening. The bond between the closure means and a target surface is also sufficient to provide a barrier seal against transmission of oxygen, moisture/moisture vapor, odor, etc. such that perishable items may be satisfactorily enclosed and preserved to the extent of the barrier properties of the material itself. The target surface may comprise a separate element of the bag or may comprise another region of the closure means itself.

As utilized herein, the term "selectively activatible" is used to refer to materials which exhibit substantially non-adherent properties when brought into contact with target surfaces until some action is taken by a user to "activate" the material to reveal adhesive properties. Accordingly, selectively-activatible properties differ from permanently-active strips of adhesive which rely upon removal of liner materials (typically silicone-coated paper strips) to expose the adhesive for use.

Selective activation of such materials allows the user to properly position opposing surfaces before activation and adhesion are accomplished, as well as minimizing the likelihood of contamination of the closure means by bag or container contents during filling operations. This characteristic permits the flexible storage bag or container to be opened, filled, and/or manipulated in any desired mode without encountering the difficulties of premature clinging or adhering of the closure means to itself or to other portions of the opening or bag/container body, and without the need for separate release sheets, liners, spacers, or the like. Preferably, the selective activation process is reversible such that the closure means may be de-activated and the bag or

container opened for filling or removal of contents and then re-activated for further closure without significant loss of adhesive capability.

Although material utilized for the closure means may be provided with two active sides or surfaces, if desired for particular applications, in accordance with the present invention it is presently preferred to provide such material with only one active side and one inactive or inert side. While under some circumstances it may be acceptable or desirable to design the closure material so as to form a discontinuous bond pattern with itself or another target surface, such as by having an intermittent or discontinuous layer of adhesive on its active surface, it is presently preferred that the closure material be designed so as to exhibit the ability to form a continuous seal or bond with itself and with any sufficiently continuous target surface.

Various means of activation are envisioned as being within the scope of the present invention, such as: mechanical activation by compression, mechanical activation by tensile forces, and thermal activation. However, it is envisioned that there may be or be developed other means of activation which would trigger an adhesive or adhesive-like character which would be capable of functioning as herein described. In a preferred embodiment the active side is activatible by an externally applied force exerted upon the sheet of material. The force may be an externally applied compressive force exerted in a direction substantially normal to the sheet of material, an externally applied tensile force exerted in a direction substantially parallel to the sheet of material, or a combination thereof.

Regardless of the manner of activation, materials useful as a closure means in accordance with the present invention will exhibit an adhesive, adherent, or tacking character as opposed to merely a clinging or affinity character. As utilized herein, therefore, the term "adhesive" is utilized to refer the ability of a material to exhibit an adherent character whether or not it actually includes a composition commonly understood and labelled as an adhesive. Accordingly, such materials will form a bond or seal when in contact with itself or another target surface as opposed to merely being attracted to such surface. While a number of approaches such as the use of selectively adherent materials may be utilized to provide the desired adhesive properties, a presently preferred approach is to utilize a pressure-sensitive adhesive.

When designing materials useful as a closure means in accordance with the present invention, it may be desirable to tailor the particular choice of adhesive agent so as to provide either a permanent bond or a releasable bond as desired for a particular application. Where a permanent bond is desired, opening of the flexible storage bag or container for access to the item(s) therein requires destruction of the bag or container.

Releasable bonds, on the other hand, provide access by permitting separation of the closure means from itself or other portions of the bag or container at the bond site without destruction. Moreover, depending upon the activation mechanism employed in the design of the material, the releasable bond may additionally be refastenable if sufficient adhesive character remains after the initial activation/bonding/release cycle.

The closure materials useful in the present invention exhibit an adhesion sufficient to survive the likely degree of handling and external or internal forces the flexible storage bag or container is likely to encounter in use while maintaining the desired level of sealing engagement with the opposing surface such that preservation of perishable items is ensured. In general, minimum adhesion which maintains a seal is desired for a closure means, so that the closure means easily peeled open for access to the stored item(s). At the same time, in a preferred embodiment the closure means is a substantially clingless material. Suitable methods of measuring and quantifying adhesive and cling properties are described in greater detail in commonly-assigned, co-pending U.S. Patent Application Serial No. 08/744,850, filed November 8, 1996 in the names of Hamilton and McGuire, entitled "Material Having A Substance Protected by Deformable Standoffs and Method of Making", the disclosure of which is hereby incorporated herein by reference.

The closure means utilized in accordance with the present invention comprises a sheet of material having a first side and a second side. The first side comprises an active side exhibiting an adhesion peel force after activation by a user which is greater than an adhesion peel force exhibited prior to activation by a user. The active side of the closure means preferably exhibits an adhesion peel force of at least about 1 ounce per linear inch, more preferably between about 1 and about 2.5 ounces per linear inch, after activation by a user.

One such material of current interest for use as a closure material in accordance with the present invention comprises a three-dimensional, conformable web comprising an active substance such as adhesive on at least one surface protected from external contact by the three-dimensional surface topography of the base material. Such materials comprise a polymeric or other sheet material which is embossed/debossed to form a pattern of raised "dimples" on at least one surface which serve as stand-offs to prevent an adhesive therebetween from contacting external surfaces until the stand-offs are deformed to render the structure more two-dimensional. Representative adhesive carrier structures include those disclosed in commonly assigned, co-pending U.S. Patent Application Serial Nos. 08/584,638, filed January 10, 1996 in the names of Hamilton and McGuire, entitled "Composite Material Releasably Sealable to a Target Surface When

Pressed Thereagainst and Method of Making", 08/744,850, filed November 8, 1996 in the names of Hamilton and McGuire entitled "Material Having A Substance Protected by Deformable Standoffs and Method of Making", 08/745,339, filed November 8, 1996 in the names of McGuire, Tweddell, and Hamilton, entitled "Three-Dimensional, Nesting-Resistant Sheet Materials and Method and Apparatus for Making Same", 08/745,340, filed November 8, 1996 in the names of Hamilton and McGuire, entitled "Improved Storage Wrap Materials". The disclosures of each of these applications are hereby incorporated herein by reference.

The three-dimensional structure comprises a piece of deformable material which has a first side formed to have a plurality of hollow protrusions separated by valleys. The plurality of hollow protrusions have outermost ends. The piece of material has a second side. The second side has a plurality of depressions therein corresponding to the plurality of hollow protrusions on the first side. The substance adheres to and partially fills the valleys between the plurality of hollow protrusions. The substance has a surface below the outermost ends of the plurality of hollow protrusions, so that when a portion of the first side of the piece of deformable film is placed against a target surface, the plurality of hollow protrusions prevent contact between the substance and the target surface until the portion is deformed at the target surface. Preferably, the plurality of protrusions deform by modes which are selected from the group consisting of inverting, crushing, and elongating. Preferably, in the inverting and/or crushing modes, each of the plurality of protrusions will not substantially deform until exposed to a pressure of at least 0.1 pounds per square inch (0.69 kPa).

Figures 8-12 illustrate a preferred embodiment of a material useful as a closure means for flexible storage bags and containers according to the present invention, which comprises a three-dimensional sheet-like structure generally indicated as 30 (also representative for 30A, 30B in Figures 8-19). Material 30 includes a deformed material 12 having hollow protrusions 14 and a layer of substance 16 located between protrusions 14. Protrusions 14 are preferably conical in shape with truncated or domed outermost ends 18. Protrusions 14 are preferably equally spaced in an equilateral triangular pattern, all extending from the same side of the material. Protrusions 14 are preferably spaced center to center a distance of approximately two protrusion base diameters or closer, in order to minimize the volume of valleys between protrusions and hence the amount of substance located between them. Preferably, the protrusions 14 have heights which are less than their diameters, so that when they deform, they deform by substantially inverting and/or crushing along an axis which is substantially perpendicular to a plane of the material. This protrusion shape and mode of deforming discourages protrusions 14

from folding over in a direction parallel to a plane of the material so that the protrusions cannot block substance between them from contact with a target surface.

Figure 10 shows a target surface 90, which is smooth but which may have any surface topography, being spaced away from layer of substance 16 by outermost ends 18 of protrusions 14. Target surfaces in accordance with the present invention will typically comprise an opposing portion of the closure periphery which may or may not itself comprise a selectively-activatible adhesive-carrying closure means of similar type. Figure 11 shows target surface 90 contacting layer of substance 16 after protrusions 14 have been partially deformed under pressure applied to the non-substance side of material 12, as indicated by force F.

The more protrusions per unit area, the thinner the piece of material and protrusion walls can be in order to resist a given deformation force. Preferred layer of substance 16 is preferably a latex pressure sensitive adhesive or a hot melt adhesive, such as that available under specification no. Fuller HL-2115X, made by H. B. Fuller Co. of Vadnais Heights, MN. Any adhesive can be used which suits the needs of the material application. Adhesives may be refastenable, releasable, permanent, or otherwise. The size and spacing of protrusions is preferably selected to provide a continuous adhesive path surrounding protrusions so that air-tight seals may be made with a target surface and a desired level of adhesion with a target surface, while also providing the optimum pattern of standoffs for selective activation.

Film materials may be made from homogeneous resins or blends thereof. Single or multiple layers within the film structure are contemplated, whether co-extruded, extrusion-coated, laminated or combined by other known means. The key attribute of the film material is that it be formable to produce protrusions and valleys. Useful resins include polyethylene, polypropylene, PET, PVC, PVDC, latex structures, nylon, etc. Polyolefins are generally preferred due to their lower cost and ease of forming. Other suitable materials include aluminum foil, coated (waxed, etc.) and uncoated paper, coated and uncoated nonwovens, scrims, meshes, wovens, nonwovens, and perforated or porous films, and combinations thereof.

Different applications for the formed closure means will dictate ideal size and density of protrusions, as well as the selection of the substances used therewith. It is believed that the protrusion size, shape and spacing, the web material properties such as flexural modulus, material stiffness, material thickness, hardness, deflection temperature as well as the forming process determine the strength of the protrusion. A "threshold" protrusion stiffness is required to prevent premature activation of the closure means due

to the weight of overlaying layers of sheets or other forces, such as forces induced by shipping vibrations, mishandling, dropping and the like.

Inversion of protrusions minimizes protrusion spring back so that higher adhesion isn't necessary in order to prevent the failure of relatively weak seals. A resilient protrusion could be used, for example, where it is intended for the bond to be permanent, where aggressive adhesive overcomes spring back. Also, a resilient protrusion may be desirable where repeat use of the material is intended.

Figure 12 shows a preferred shape of the protrusions and valleys of closure means of the present invention, which enables protrusions to substantially invert and/or crush as a mode of deforming. The preferred shape minimizes protrusion fold-over and interference with substance placed in valleys between protrusions, or inside hollow protrusions, or both. Also, the preferred shape helps to ensure a repeatable, predictable, resistance to protrusion deformation. Figure 12 shows that each protrusion is defined by a height dimension A and a base diameter dimension B. A preferred ratio of base diameter B to height A, which enables protrusions to substantially invert and/or crush without fold-over, is at least 2:1.

Figure 13 shows a suitable method for making a material such as the material 30 useful in accordance with the present invention, which is generally indicated as 180 in Figure 13.

The first step comprises coating a forming screen with a first substance. The forming screen has a top surface and a plurality of recesses therein. The coating step applies the first substance to the top surface without bridging the recesses. A second step includes introducing a piece of material, which has a first side and a second side, onto the forming screen such that the first side is in contact with the first substance on the top surface of the forming screen. The first substance preferentially adheres to the first side of the piece of material. A third step includes forming the piece of material to create a plurality of hollow protrusions extending from the first side into the recesses of the forming screen. The plurality of hollow protrusions are spaced apart by valleys into which the first substance is transferred from the forming screen. The plurality of hollow protrusions are accurately registered with the first substance by use of a common transfer and forming surface. The first substance forms an interconnected layer in the valleys between the protrusions.

Forming screen 181 is threaded over idler pulley 182 and a driven vacuum roll 184. Forming screen 181 is preferably a stainless steel belt, having the desired protrusion pattern etched as recesses in the belt. Covering the outer surface of vacuum

roll 184 is a seamless nickel screen which serves as a porous backing surface for forming screen 181.

For producing a pressure sensitive adhesive containing material, a substance 186, preferably hot melt adhesive, is coated onto forming screen 181 by a substance applicator 188 while forming screen 181 rotates past the applicator. A web of material 190 is brought into contact with the substance coated forming screen at material infeed idler roll 192. Hot air is directed radially at material 190 by a hot air source 194 as the material passes over vacuum roll 184 and as vacuum is applied to forming screen 181 through vacuum roll 184 via fixed vacuum manifold 196 from a vacuum source (not shown). A vacuum is applied as the material is heated by hot air source 194. A formed, substance coated material 198 is stripped from forming screen 181 at stripping roll 200. Because the same common forming screen is used to transfer the substance to the material as is used to form the protrusions, the substance pattern is conveniently registered with the protrusions.

Stainless steel forming screen 181 is a fabricated, seamed belt. It is fabricated in several steps. The recess pattern is developed by computer program and printed onto a transparency to provide a photomask for photoetching. The photomask is used to create etched and non-etched areas. The etched material is typically stainless steel, but it may also be brass, aluminum, copper, magnesium, and other materials including alloys. Additionally, the recess pattern may be etched into photosensitive polymers instead of metals. Suitable forming structures are described in greater detail in the above-referenced and above-incorporated Hamilton et al. and McGuire et al. patent applications.

Materials of the foregoing variety when utilized as a closure means in accordance with the present invention may be unitarily formed and constructed as part of the body of the flexible storage bag or container either before, during, or after assemblage of the bag from its material components. Alternatively, such closure means may also be separately formed and joined to the body of the flexible storage bag or container either before, during or after assemblage of the bag. Such joining may be edge-wise or may be accomplished as a lamination or bonding of the material facially onto a superposed portion of the bag or container body, such lamination being particularly advantageous when it is desired to add additional thickness, stiffness, and/or resiliency to the region of the bag or container comprising the closure means. The material utilized for the closure means may be the same as or different from the material utilized to form the bag or container body either in dimensions or in composition.

Particularly useful as a flange material in accordance with the present invention is a self-supporting, semi-rigid, resilient polymeric or coated paper sheet material with a closure means laminated thereto such that the active side of the closure means faces away from the flange material, such that a composite closure means is formed having a plurality of highly-deformable stand-offs with a substantially more resilient, more self-supporting base material. Materials found suitable for use in accordance with the present invention include a low density polyethylene sheet material, 0.020 inch thickness, commercially available from Huntsman Film Products Corp. under the manufacturer's designation X420.

To facilitate separation of adhered or bonded overlying portions of the closure means material, various adaptations or modifications may be accomplished in terms of integration of the material into the overall structure of the flexible storage bag or container. For example, it may be desirable to provide extension tabs (such as tabs 35 shown in Figures 1-7) on opposing sides of the opening periphery to facilitate manual initiation of closure separation. It may also be desirable to leave a small but finite portion of the bag or container body immediately adjacent to the opening periphery free of closure material, such that there is a non-adherent rim of material which may be utilized to initiate material separation and hence opening of the flexible storage bag or container.

In accordance with the present invention, the use of selectively-activatible adhesive materials for the closure means 30 provides the user with an easy-to-operate closure means for closing and sealing an opening in a flexible storage bag or container. The closure means 30 is easy to manipulate with one or two hands, as the only dexterity required is to grasp or pinch the closure means with a pair of opposed digits to activate the material against an opposing surface of the bag or container body or closure means. Moving the grasping digits across the extent of the opening provides secure adhesion of the closure means across the extent of the opening, thereby converting the flexible bag or container from a semi-enclosed container to a fully closed container. Particularly when the closure means fully encircles the opening in the bag or container body, the closure means 30 is highly tolerant to misalignment as it will adhere to any opposing surface unlike mechanical closure mechanisms which typically require precise alignment of mating elements.

The ability of the closure means to be activated by pinching or grasping superimposed portions of the bag or container body is particularly advantageous with flexible, conformable structures such as the flexible storage bags and containers of the present invention. More particularly, such structures are yieldable under applied forces

and accordingly, it would be difficult to activate a seal by exerting pressure upon the bag or container as a whole against a surface, particularly when filled, as such would tend to expel bag or container contents as sealing of the closure is attempted. Therefore, the use of a closure means as herein described permits secure, reliable sealing of even highly flexible storage bags or containers.

Because the closure means in a preferred configuration employs a layer of adhesive protected by a plurality of three-dimensional protrusions, rather than a three-dimensional mating pair of interlocking elements, it is possible to employ such a closure means successfully in a confined, non-parallel region of the bag or container body such as the region near the hinges 32 without providing leakage sites such as the ends of the mechanical elements. Accordingly, the closure means 30 of the present invention provides additional security and confidence in the level of sealing obtained for situations where a leakproof seal is important.

Although the self-supporting flexible storage bags illustrated in the foregoing Figures 1-7 and 15-19 have been constructed of flexible sheet material along the lines of the approach typically taken for paper grocery-type bags, as illustrated for example in U.S. Patent No. 584,555, issued June 15, 1897 to Lorenz, a wide variety of other constructions may be utilized in keeping with the self-supporting approach in conjunction with the use of a closure means in accordance with the present invention. Examples of such other illustrative bag designs include U.S. Patent Nos. 3,970,241, issued July 20, 1976 to Hanson, 5,061,500, issued October 29, 1991 to Mendenhall, 5,195,829, issued March 23, 1993 to Watkins et al., and 5,314,252, issued May 24, 1994 to Happ. Also illustrative is commonly-assigned U.S. Patent No. 4,898,477, issued February 6, 1990 to Cox et al., the disclosure of which is hereby incorporated herein by reference.

In addition to such use of sheet material folded and sealed to form the bag or container body, the bags or containers may be constructed in any known and suitable fashion such as those known in the art for making such bags or containers in commercially available form. Heat or adhesive sealing technologies may be utilized to join various components or elements of the bag or container to themselves or to each other. In addition, the bag or container bodies may be thermoformed, blown, or otherwise molded from a starting blank or sheet of material rather than reliance upon folding and bonding techniques to construct the bag or container bodies from a web or sheet of material.

While particular embodiments of the present invention have been illustrated and described, it would be obvious to those skilled in the art that various other changes and

modifications can be made without departing from the spirit and scope of the invention. It is therefore intended to cover in the appended claims all such changes and modifications that are within the scope of this invention.

WHAT IS CLAIMED IS:

1. A flexible storage bag comprising at least one sheet of flexible sheet material assembled to form a semi-enclosed container having an opening defined by a hinged peripheral flange, characterized in that said hinged flange includes a closure means for sealing said opening to convert said semi-enclosed container to a closed container, wherein said container is self-supporting and maintains said opening in an upwardly-extending condition.

2. The flexible storage bag of Claim 1, further characterized in that said bag includes at least one pair of opposed gussets formed in said sheet material extending in a direction normal to said opening and a substantially planar bottom extending in a direction substantially parallel to said opening, such that when said bottom is placed on a horizontal surface said container is self-supporting and maintains said opening in an upwardly-extending condition.

3. The flexible storage bag of Claim 1 or Claim 2, further characterized in that said closure means comprises a piece of material forming at least a portion of said hinged flange, said piece of material having a first side facing inwardly toward said opening and a second side facing outwardly of said opening, said first side exhibiting an adhesion peel force after activation by a user which is greater than an adhesion peel force exhibited prior to activation by a user.

4. A collapsible, stackable, self-restorable container comprising:
   (a) a unitary continuous tubular sidewall having a first open end and a second open end and defining an axial direction extending through said first and second open ends, said first open end having a substantially continuous outwardly-extending flange forming a periphery of said first open end, said tubular sidewall being collapsible in response to an externally-applied force exerted in an axial direction and being self-restorable when said force is removed;
   (b) a bottom panel unitarily formed with said second open end of said tubular sidewall and enclosing one end of said tubular sidewall to form a semi-enclosed container;
   (c) a lid for selectively converting said semi-enclosed container to a closed container; and

(d) a closure means for sealing said lid to said flange;

characterized in that said closure means comprises a piece of material forming at least a portion of said periphery, said piece of material having a first side facing inwardly toward said opening and a second side facing outwardly of said opening, said first side exhibiting an adhesion peel force after activation by a user which is greater than an adhesion peel force exhibited prior to activation by a user.

5. The collapsible, stackable, self-restorable container of Claim 4, further characterized in that said tubular sidewall and said bottom panel are thermoformed from a continuous sheet of material.

6. A collapsible, foldable, stackable, and self-supportable container comprising:

(a) a semi-enclosed container body comprising two opposed side walls, two opposed end walls between said side walls, said side walls and said end walls together forming a tubular structure having two open ends, and a bottom panel enclosing one end of said container body, the other end of said tubular structure opposite from said bottom panel forming a periphery;

(b) a lid for selectively converting said semi-enclosed container to a closed container; and

(c) a closure means for sealing said lid to said container body;

characterized in that each of said side walls includes a gusset extending in a direction substantially parallel to said bottom panel said side walls and said end walls are inwardly foldable toward one another, such that said container is collapsible in a direction normal to said lid and said bottom panel while being substantially self-supporting while said side walls and said end walls are in their unfolded orientation.

7. The collapsible, foldable, stackable, and self-supportable container of Claim 6, further characterized in that said side walls, said end walls, and said bottom panel are unitarily formed from a continuous sheet of material.

8. The collapsible, stackable, self-supportable container of Claim 6 or Claim 7, further characterized in that said end panels include diagonal reinforcing folds.

9. The storage bag or container of any one of Claims 1 or 4 or 6, further characterized in that said closure means is activatible by an externally applied compressive force exerted in a direction substantially normal to said flange.

10. The storage bag or container of any one of Claims 1 or 4 or 6, further characterized in that said closure means comprises a three-dimensional sheet material which is convertible to a substantially two-dimensional sheet material upon activation by a user to expose an adhesive layer to contact with a complementary surface of said semi-enclosed container across said opening.

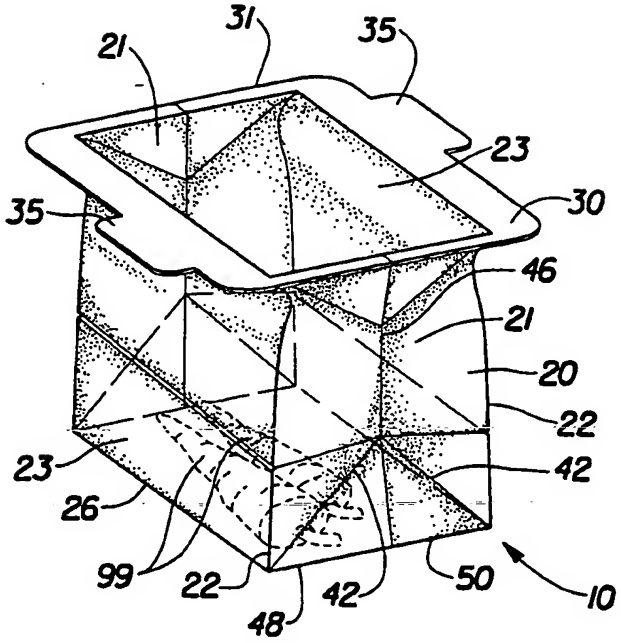


Fig. 1

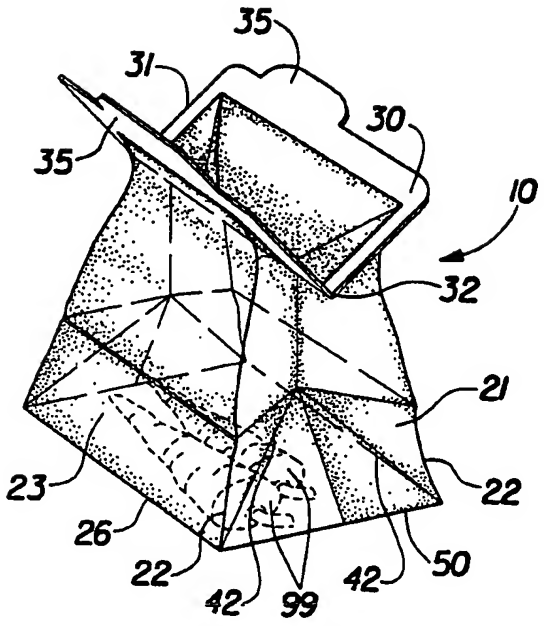


Fig. 2

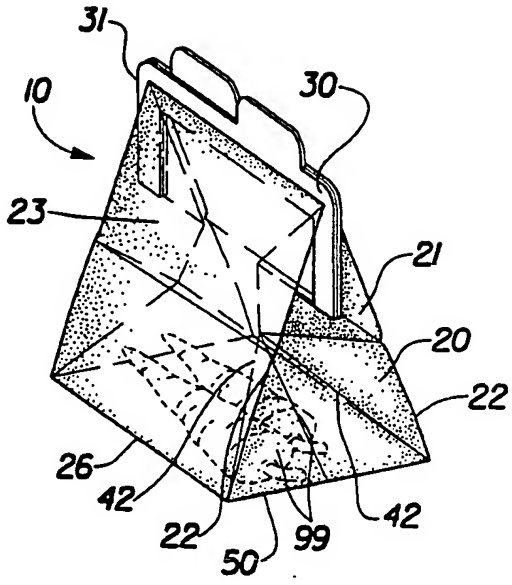


Fig. 3

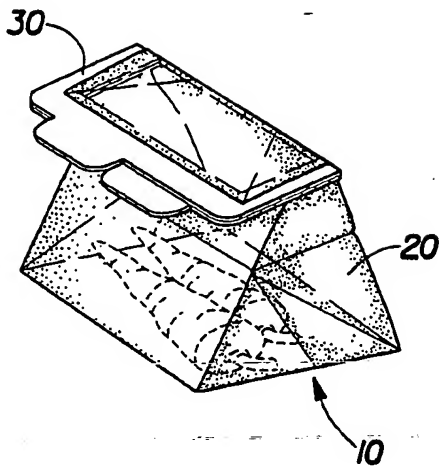


Fig. 4

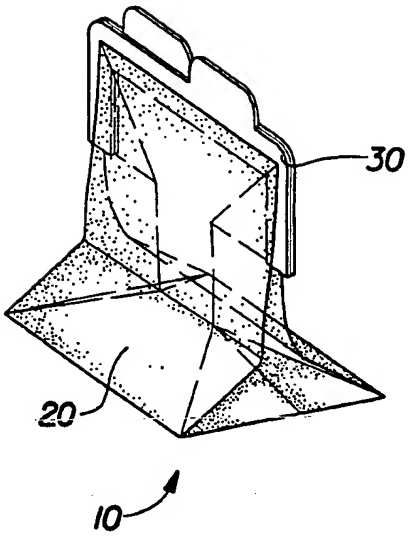


Fig. 5

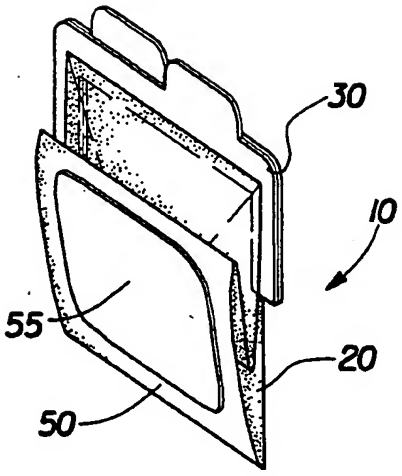


Fig. 6

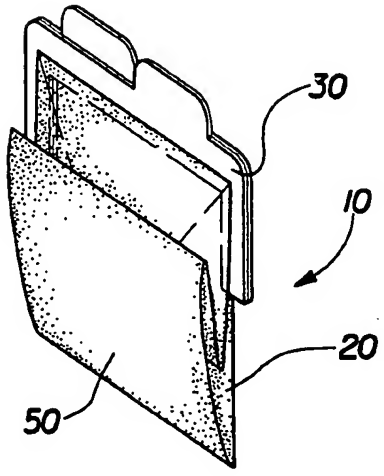
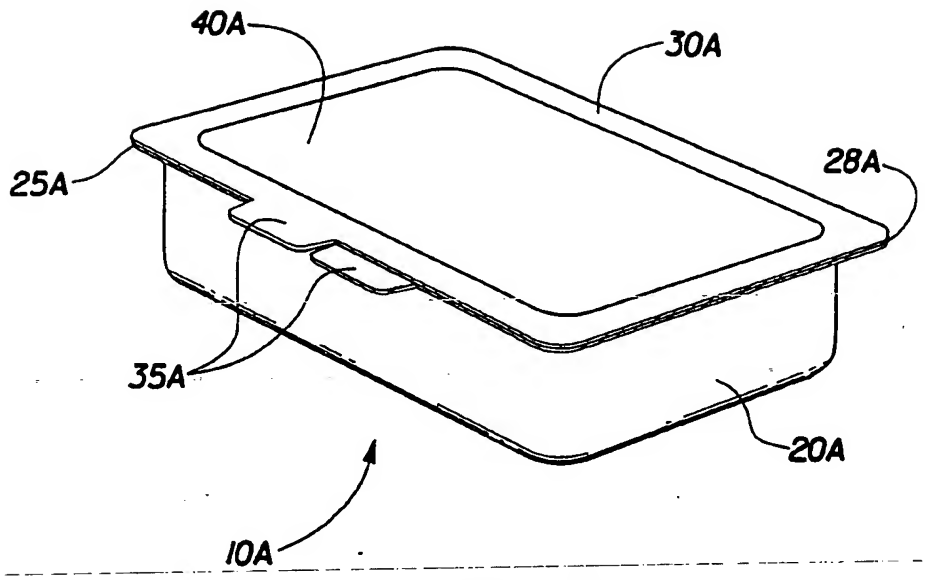


Fig. 7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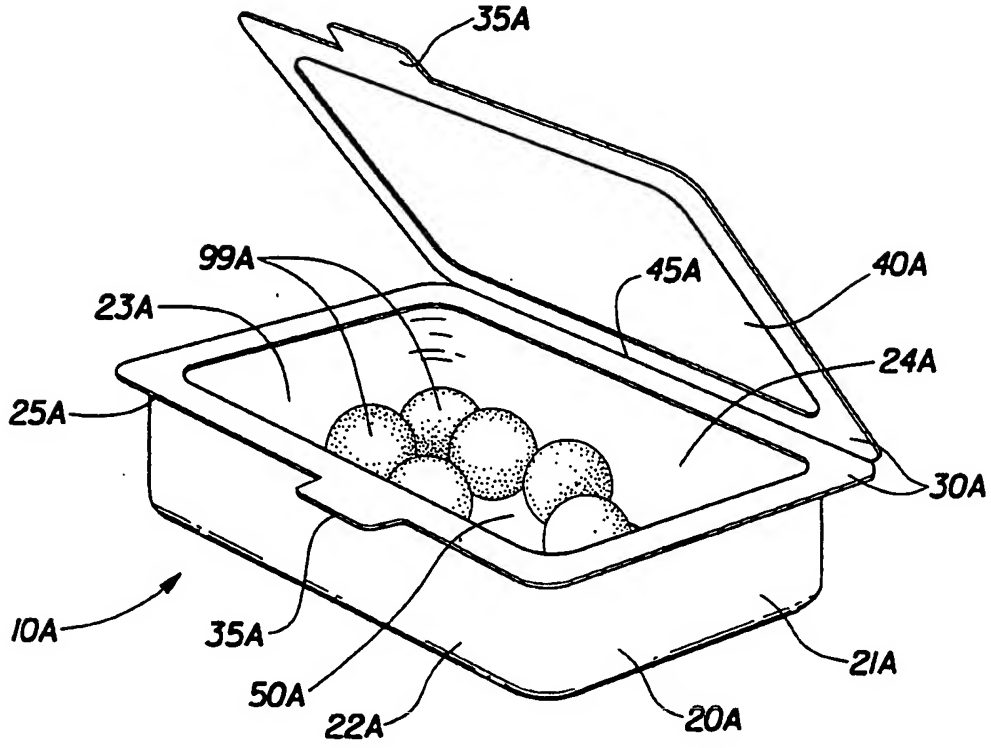
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Fig. 9

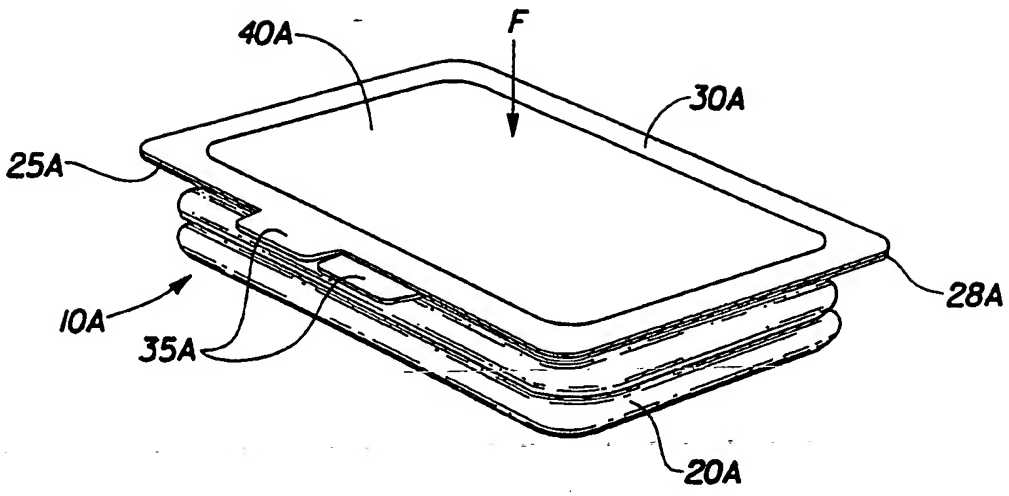
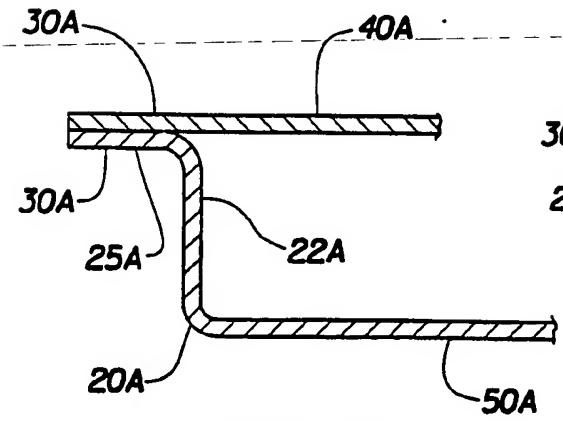


Fig. 10



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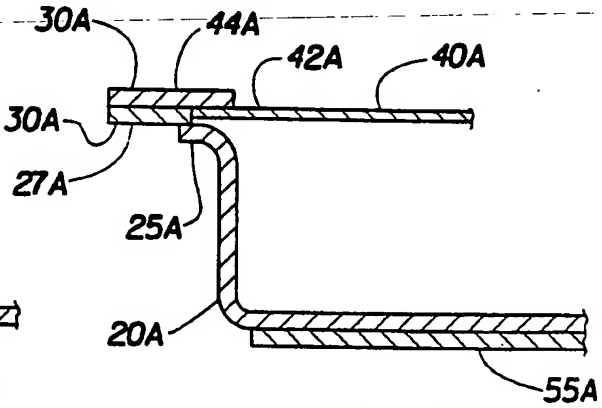

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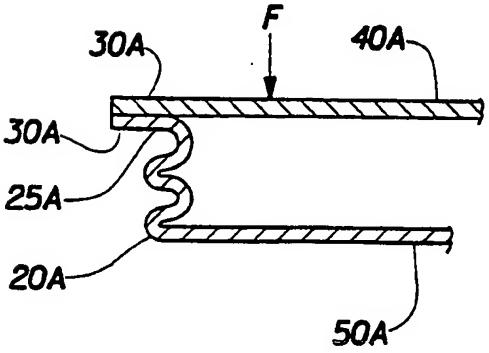

Fig. 13

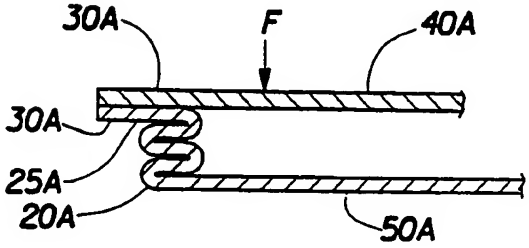

Fig. 14

Fig. 15

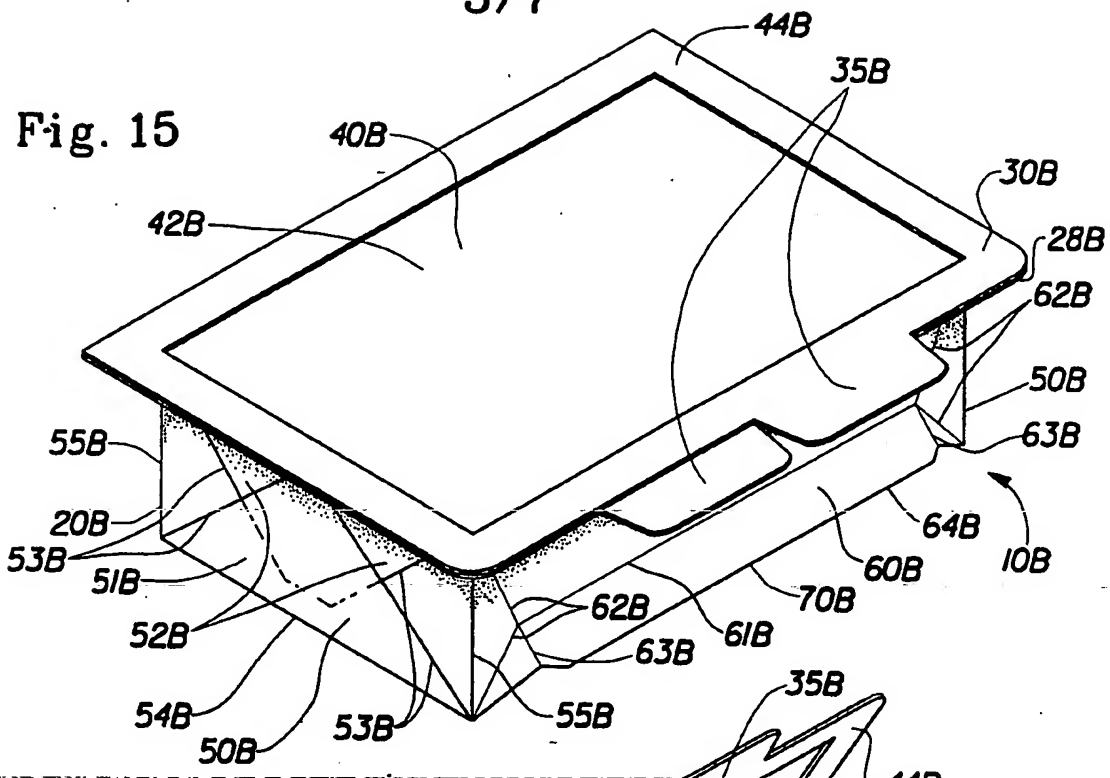
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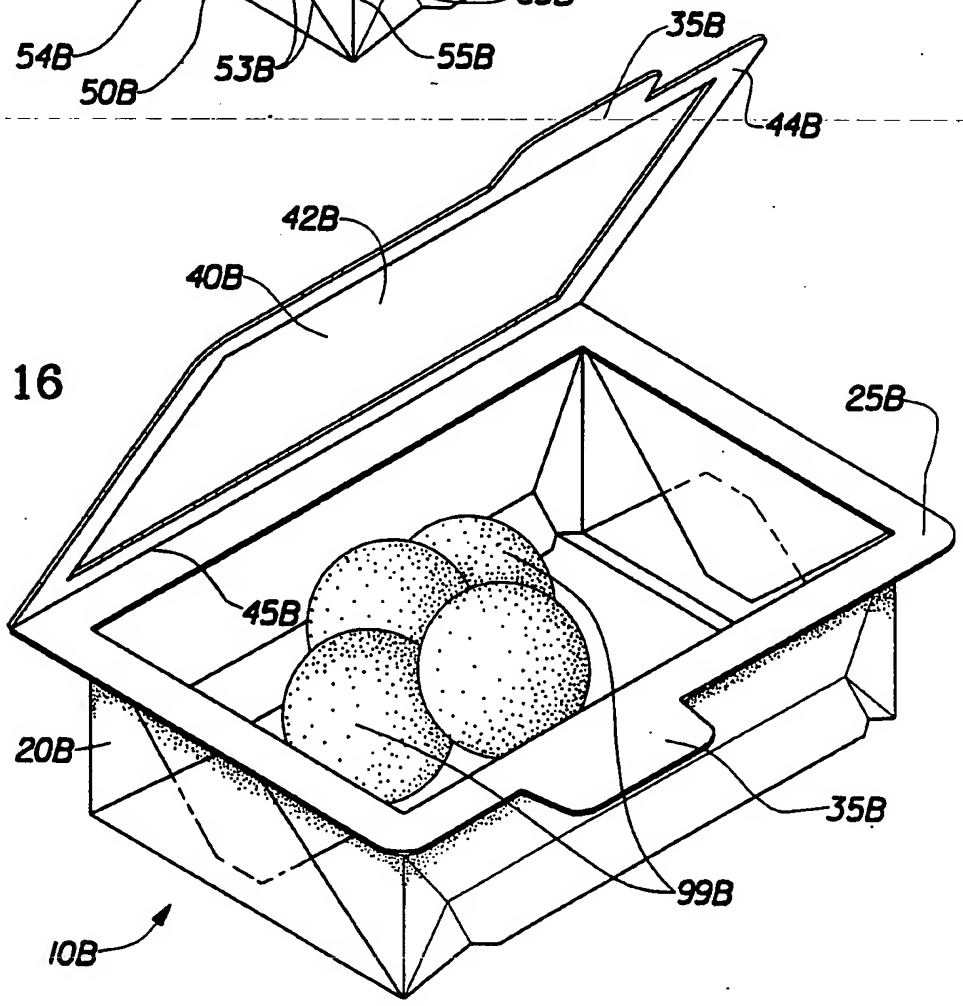
Fig. 16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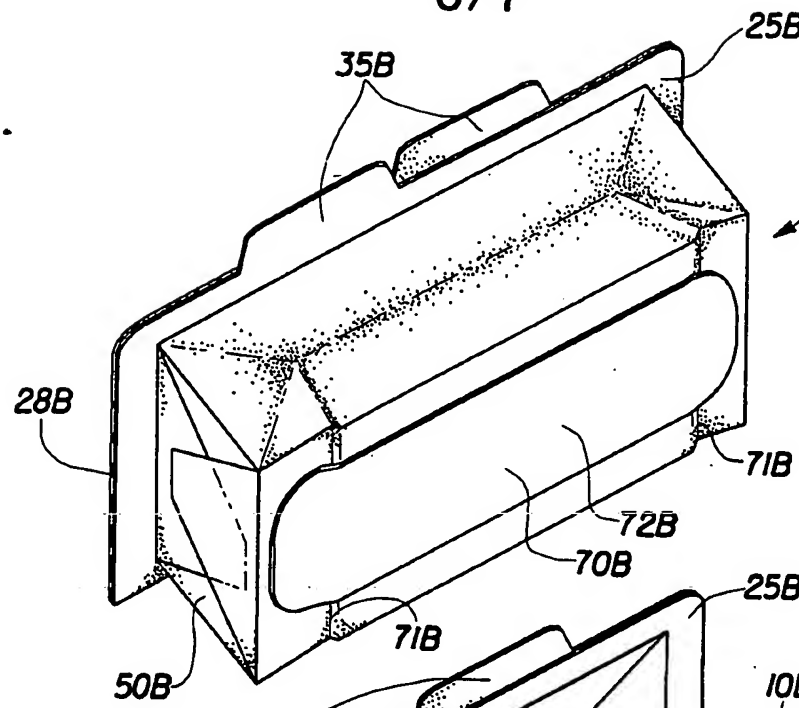

Fig. 17

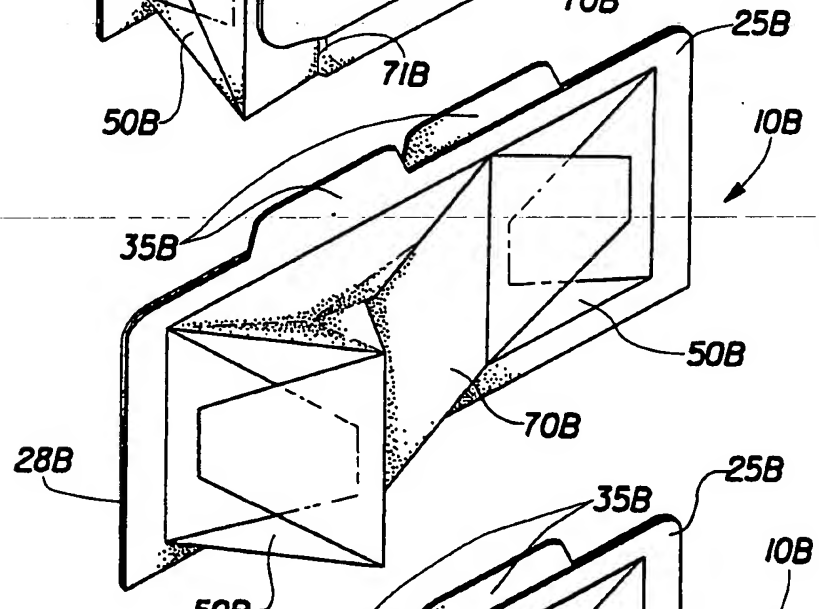

Fig. 18

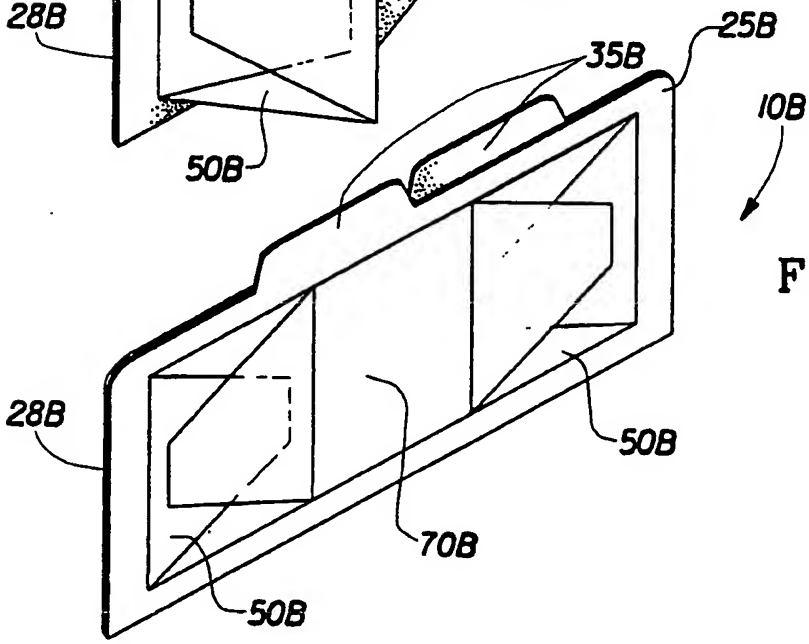

Fig. 19

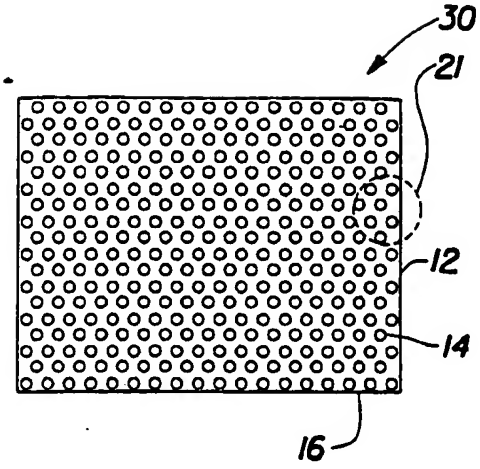

Fig. 20

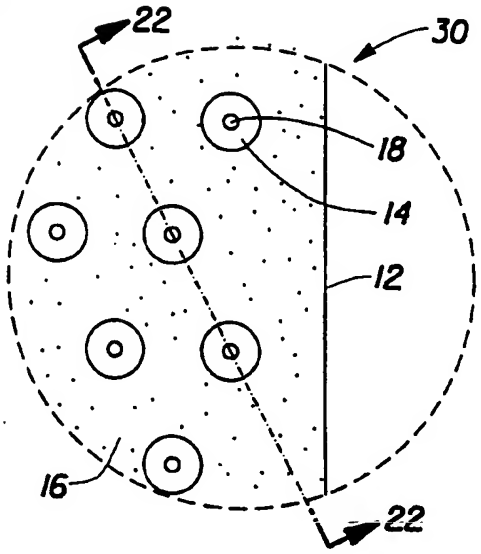

Fig. 21

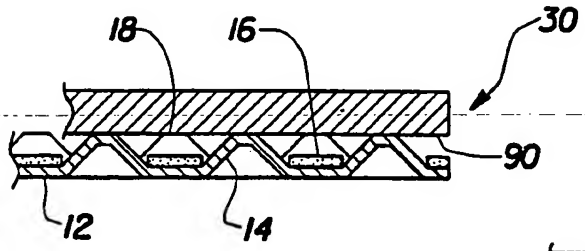

Fig. 22

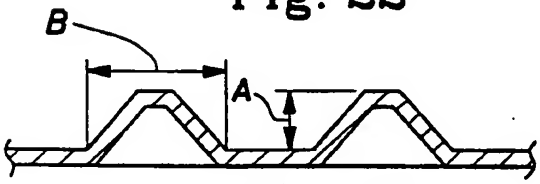

Fig. 24

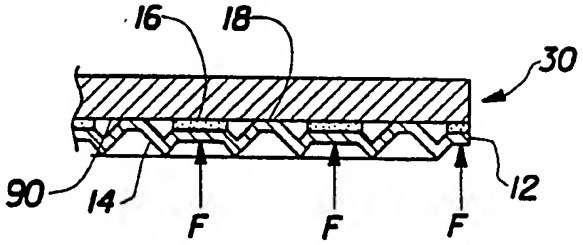

Fig. 23

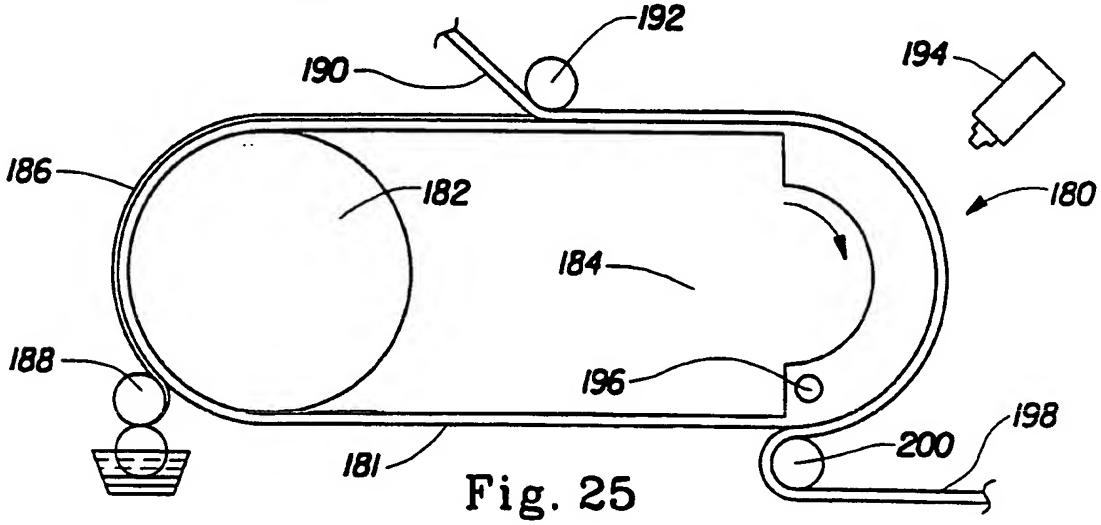

Fig. 25

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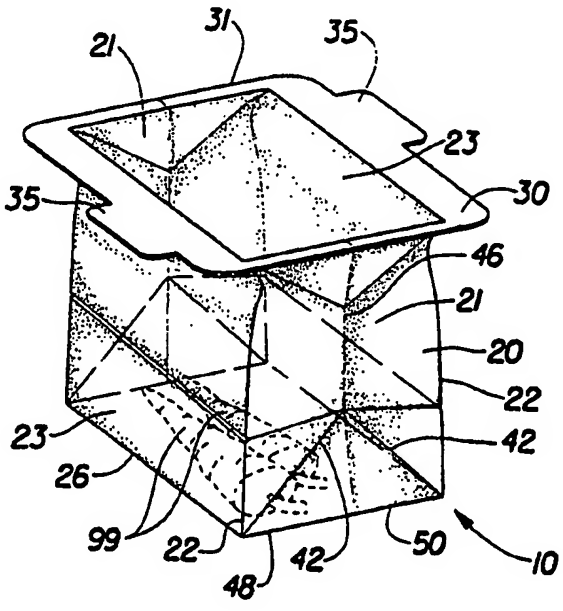
(54) Title: FLEXIBLE, COLLAPSIBLE, SELF-SUPPORTING STORAGE BAGS AND CONTAINERS

(57) Abstract

The present invention provides a flexible storage bag (10) comprising at least one sheet of flexible sheet material assembled to form a semi-enclosed container having an opening defined by a hinged peripheral flange (31). The hinged flange includes a closure means for sealing the opening to convert the semi-enclosed container to a closed container. When the bottom is placed on a horizontal surface the container is self-supporting and maintains the opening in an open condition. The present invention also provides a collapsible, stackable, self-restorable container (10A) comprising a unitary continuous tubular side wall having a first open end and a second open end defining an axial direction extending through the first and second open ends. The tubular sidewall is collapsible in response to an externally-applied force exerted in its axial direction and is self-restorable when the force is removed. A lid (40A) attached to the tubular side wall for selectively converting the semi-enclosed container to a closed container completes the storage container, and a closure means is provided for sealing the lid to the tubular sidewall.



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INTERNATIONAL SEARCH REPORT

International Application No
PCT/US 98/09216

A. CLASSIFICATION OF SUBJECT MATTER
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According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
IPC 6 B65D

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	FR 2 184 972 A (SCHUILING) 28 December 1973 see page 2, line 13 - page 3, line 9; figures	1
A	GB 1 575 657 A (PEAKE) 24 September 1980 see page 1, line 70 - line 100; figures	1

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Date of the actual completion of the international search	Date of mailing of the international search report
8 September 1998	30. 12. 98

Name and mailing address of the ISA	Authorized officer
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Form PCT/ISA/210 (second sheet) (July 1992)

INTERNATIONAL SEARCH REPORT

International application No.
PCT/US 98/09216

Box I Observations where certain claims were found unsearchable (Continuation of item 1 of first sheet)

This International Search Report has not been established in respect of certain claims under Article 17(2)(a) for the following reasons:

1. ☐ Claims Nos.:
because they relate to subject matter not required to be searched by this Authority, namely:

2. ☐ Claims Nos.:
because they relate to parts of the International Application that do not comply with the prescribed requirements to such an extent that no meaningful International Search can be carried out, specifically:

3. ☐ Claims Nos..
because they are dependent claims and are not drafted in accordance with the second and third sentences of Rule 6.4(a).

Box II Observations where unity of invention is lacking (Continuation of item 2 of first sheet)

This International Searching Authority found multiple inventions in this international application, as follows:

please see attached sheet!

1. ☐ As all required additional search fees were timely paid by the applicant, this International Search Report covers all searchable claims.

2. ☐ As all searchable claims could be searched without effort justifying an additional fee. this Authority did not invite payment of any additional fee.

3. ☐ As only some of the required additional search fees were timely paid by the applicant. this International Search Report covers only those claims for which fees were paid, specifically claims Nos.:

4. ☒ No required additional search fees were timely paid by the applicant. Consequently, this International Search Report is restricted to the invention first mentioned in the claims; it is covered by claims Nos.:

1-3, 9, 10

Remark on Protest

☐ The additional search fees were accompanied by the applicant's protest.

☐ No protest accompanied the payment of additional search fees.

FURTHER INFORMATION CONTINUED FROM PCT/ISA/ 210

This International Searching Authority found multiple (groups of) inventions in this international application, as follows:

1. Claims: 1-3 9 10

   A bag of flexible sheet material having a centrally hinged flange closure whose hinge action pulls together the front and back walls of the bag on closing.

2. Claims: 4-8

   A collapsible container having a lid hinged at a container sidewall whereby the lid is sealed to the container body on closing

INTERNATIONAL SEARCH REPORT

nformation on patent family members

Int ·ational Application No
PCT/US 98/09216

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
FR 2184972 A	28-12-1973	NL 7206665 A	20-11-1973
		BE 799632 A	16-11-1973
		DE 2324431 A	29-11-1973
GB 1575657 A	24-09-1980	NONE	